ENGINEERING AND OPTIMISATION OF INTERFACES IN HIGH-PERFORMANCE SOFC TECHNOLOGIES

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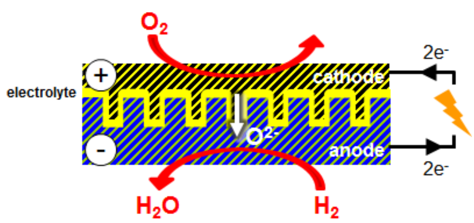
$1/2O_2 + 2e^- \rightarrow O^{2-}$



$H_2 + O^{2-} \rightarrow H_2O + 2e^-$

Architectured electrode/electrolyte interfaces in a SOFC technologie

- Anode self-supporting SOFC
- Optimisation of the 3D microstructure of cell components
- Modelling as a support tool to optimise the topography of the electrode/electrolyte interfaces
- Integration of geometrical pattern using simple laboratory processes
- Increase durability and lower costs

Abstract:

The development of SOFC is constrained by the existence of scientific and technical locks caused by their high operating temperature, together with the formation of water in the anode compartment. An improvement in their performance would allow a lowering of the operating temperature, which would meet the requirements of durability and cost. Recent studies have shown the correlation between the density of TPB (where electrochemical reactions take place) in the anode, near the anode/electrolyte interface, and the power density delivered by a SOFC. Indeed, in the case of a ceramic-metal anode, the electrochemical reactions occur mainly in the vicinity of the anode/electrolyte interface, in an effective zone called "effective thickness" of the electrode which extends over a distance of about 10 µm. Thus, a high density of TPB must be present over the extent of this most active exchange zone to thereby achieve better performance. Therefore, a topological control of the anode/electrolyte interface to dimensions between the effective thickness and the total thickness of the electrode is a promising strategy to improve performances. As part of this thesis, it is proposed to fabricate these interfaces experimentally. The associated performances will be measured and compared with those resulting from electrochemical modeling. The cells will also be tested over long time and finely characterized using advanced tools (FIB-SEM, FEI Titan Cube microscope) of the Equipex MATMECA that will connect the local structure and chemical composition of materials and interfaces to the simulated current densities. The manufacturing processes, as well as the geometrical characteristics of the interfaces obtained, will be connected to the electrochemical performances and the mechanical behaviour of the stacks. This study will be based on refined electrochemical and thermomechanical modeling that will identify the most active areas of the cell, i.e. where current densities are highest, and areas of high residuals stress that are likely to induce weakening points in the stack.